

Fire History and Fire Risk in Boulder County Forests

Boulder County Forest Fire Science
Boulder Public Library
2015

Tania Schoennagel, PhD
University of Colorado-Boulder
INSTAAR and Geography

Dramatic Changes in Boulder County

- Accumulation of wildland fuels in some forest types due to past fire suppression
- Rapid expansion of the wildland-urban interface
- More wildfires in the Front Range





Phil Armitage

Boulder County



Patrick Cullis

- Historical fire regimes: effects of past fire suppression on forest restoration need
- Growth in the wildland-urban interface (WUI): increased fire risk
- Past and future trends in wildfire



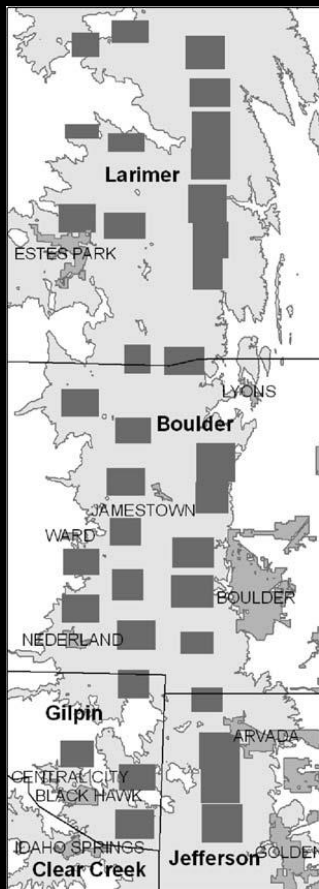
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Boulder County



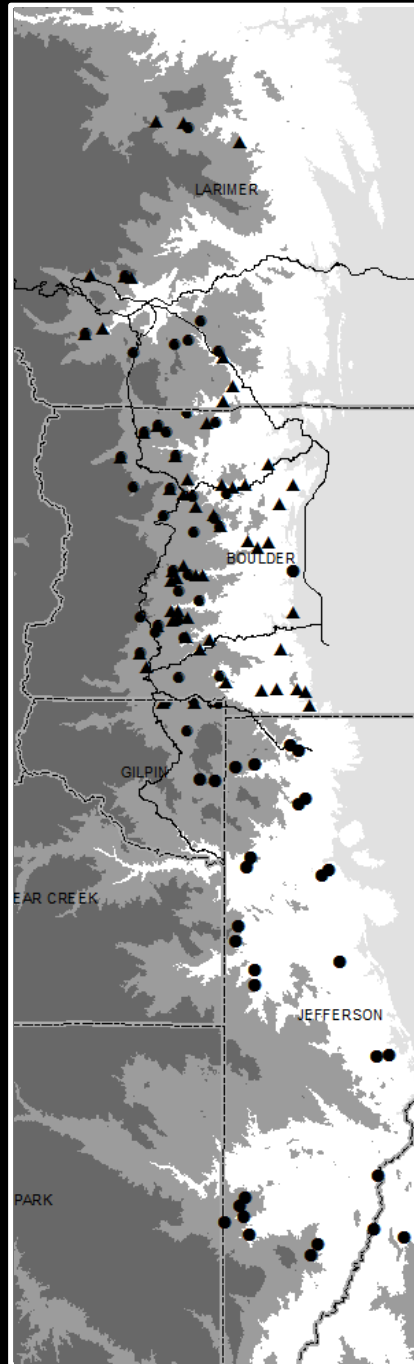
Patrick Cullis

- **Historical fire regimes:** effects of past fire suppression on forest restoration need
- Growth in the wildland-urban interface (WUI): increased fire risk
- Past and future trends in wildfire



Historical Aerial Photo Comps

- Fire History and Age Structure
- ▲ Fire History
- >100 sites in the CFR



Front Range Fire History Studies

Veblen et al. 2000 *Ecological Applications*

Sherriff, Veblen 2006 *Journal of Vegetation Science*

Sherriff, Veblen 2007 *Ecosystems*

Platt, Schoennagel 2009 *Forest Ecology & Management*

Schoennagel et al. 2011 *Ecological Applications*

Gartner et al. 2012 *J. of Vegetation Science*

Sherriff et al. 2014 *PLoS ONE*

Dickinson 2014 *Forest Ecology & Management*

Brown et al. 2015 *Canadian Journal of Forest Research*

- >9000 ft Subalpine
- 7400-9000 ft Upper Montane
- 6000-7400 ft Lower Montane
- <6000ft Grassland

Boulder County Forests



Charles Pfeil

Subalpine
>9000'

Upper Montane
7400-9000'

Lower Montane
6000-7400'

Boulder County Forests



Infrequent
High-severity



Frequent
Low-severity



Subalpine
>9000'

Upper Montane
7400-9000'

Lower Montane
6000-7400'

Boulder County Forests



Infrequent
High-severity



Frequent
Low-severity



Subalpine
>9000'

Upper Montane
7400-9000'

Lower Montane
6000-7400'

Lower Montane Forests

- Seasonally dry, hot: 1970-2006
31% of fires burned in low elevation forests.
- Ponderosa pine
- Historically open woodlands
- Historical fire regime:
frequent, low-severity,
surface fires
- Interval between fires: 10-
30 years



Frequent
Low-severity

Lower Montane Forests

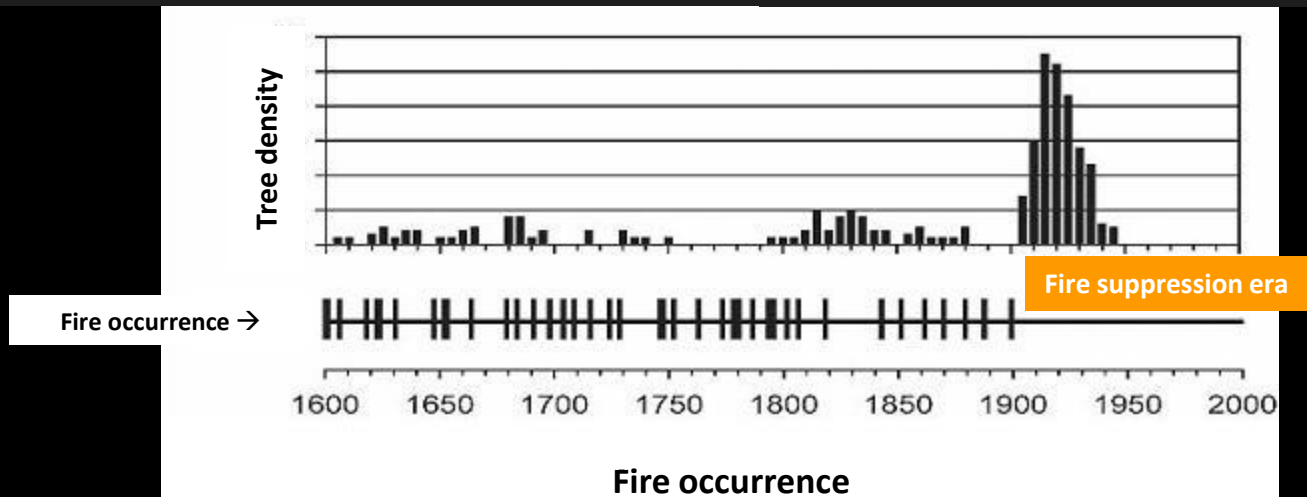
- Smokey Bear: successful fire prevention program with unintended consequences.
- Past suppression of frequent, low-severity ground fires led to fuels build up.



Lower Montane forests

Frequent, low-severity fires.

Fuels build-up in response to fire suppression, grazing.



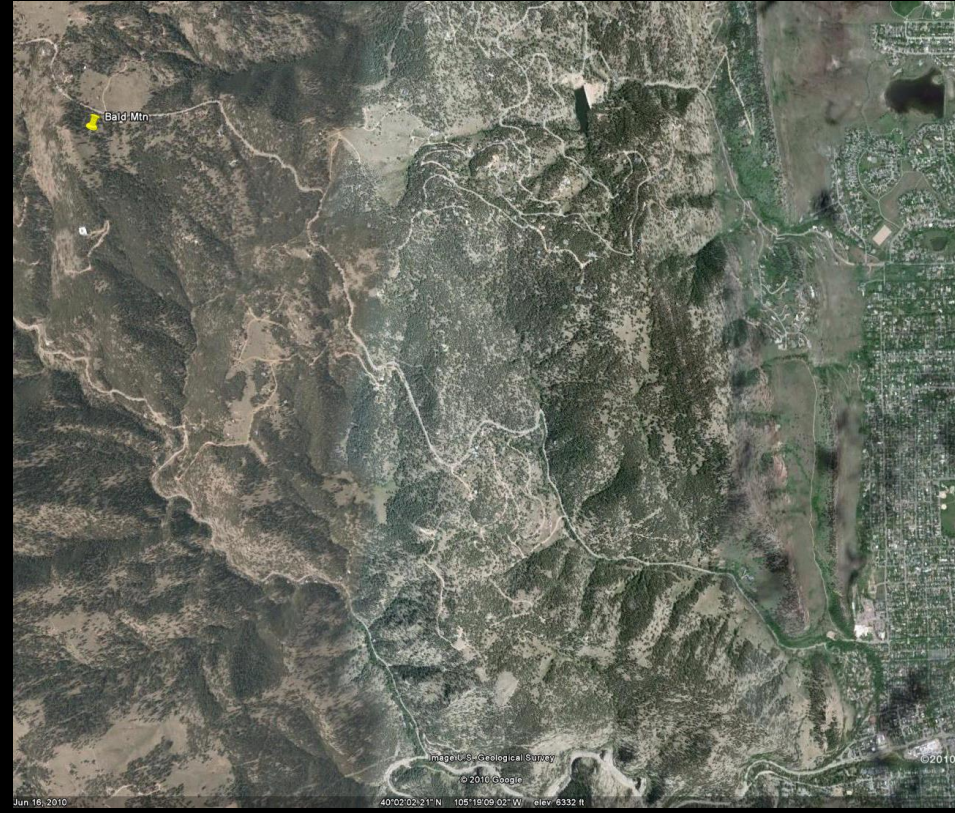
Allen et al. 1998
Veblen and Lorenz 1986

Lower Montane: Sunshine Canyon/Bald Mountain

~7000 ft (2135 m)



1940



2002

40 02 04, -105 18 58

Lower Montane Zone

(low-elevation ponderosa forests)

- Denser than historically
- With higher fuel loads, the risk of crown fire has increased
- Thinning and Rx fire can reduce tree densities, fuels, fire severity
- Such management should
restore forests and reduce fire severity



Boulder County Forests



Infrequent
High-severity



Frequent
Low-severity



Subalpine
>9000'

Upper Montane
7400-9000'

Lower Montane
6000-7400'

Infrequent
High-severity

Subalpine Forests



Generally moist, cool:
1970-2006 : 5% of fires burned in
subalpine forests

Lodgepole pine,
Engelmann spruce,
Subalpine fir

Historically very dense

Historical fire regime:
Infrequent (100+ yrs)
high-severity crown fires



Subalpine forests

Infrequent, high-severity fires.

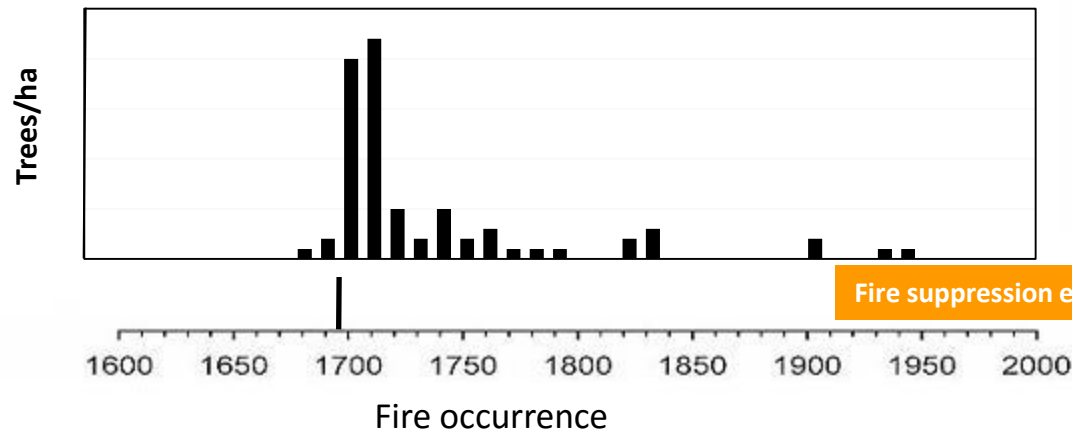
High fuels loads common before and now. Minimal fuel build-up.



1916



1986



Fire suppression era

Veblen and Lorenz 1986
Sibold 2005

Subalpine fire history: Large, infrequent, high severity fires



1898



1930

Boulder County Forests



Infrequent
High-severity



Frequent
Low-severity

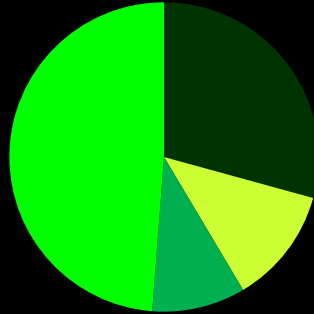


Subalpine
>9000'

Upper Montane
7400-9000'

Lower Montane
6000-7400'

Upper Montane Forests



- Ponderosa pine
- Lodgepole pine
- Aspen
- Douglas-fir



Ponderosa pine



Douglas-fir



Aspen



Lodgepole pine

Upper Montane Forests



Upper Montane Forests

High and mixed severity fires historically.

Lower severity and lower densities on s-facing, more gentle slopes.

Majority of trees established prior to 1920.

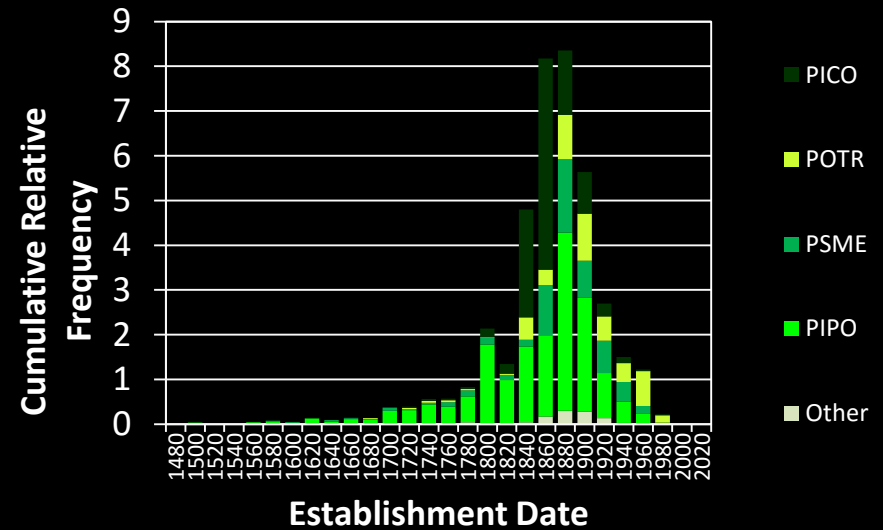
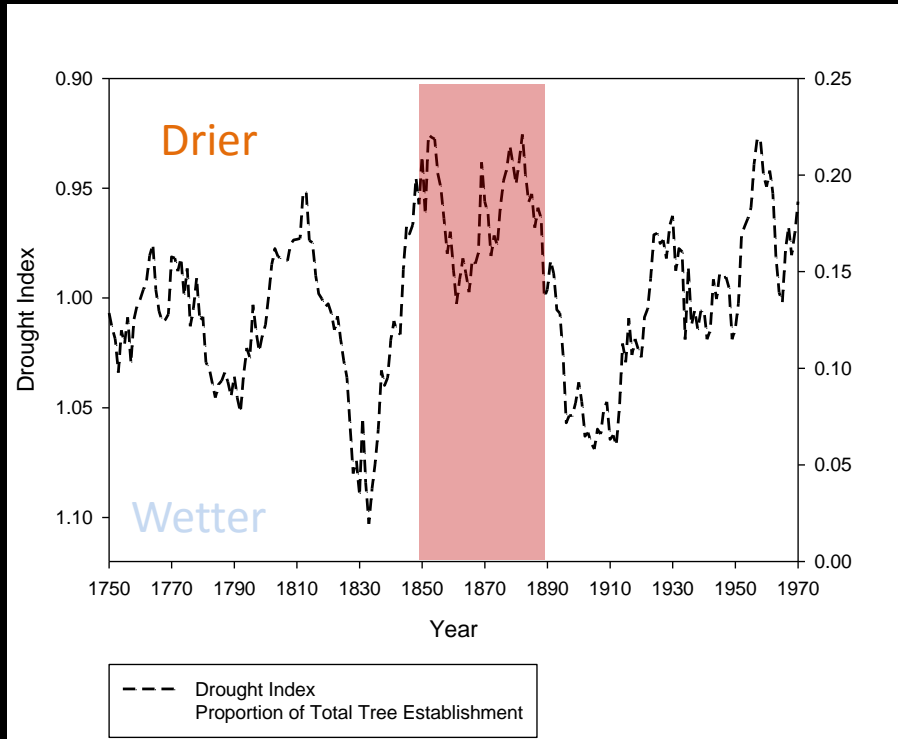


Schoennagel et al. 2011
Sherriff et al. 2014



Upper Montane Forests

53% of the fires in the Upper Montane burned during the 1850-1890 period.



Fires strongly associated with drought

Upper Montane Forests

Moister and cooler than lower montane, drier than subalpine

Ponderosa, Douglas-fir, Lodgepole, Aspen

Complex zone: historically, fire severity and tree density varied with topography.

Historical fire regime: **mixed-severity**

Ave. fire intervals: 40-100+ years



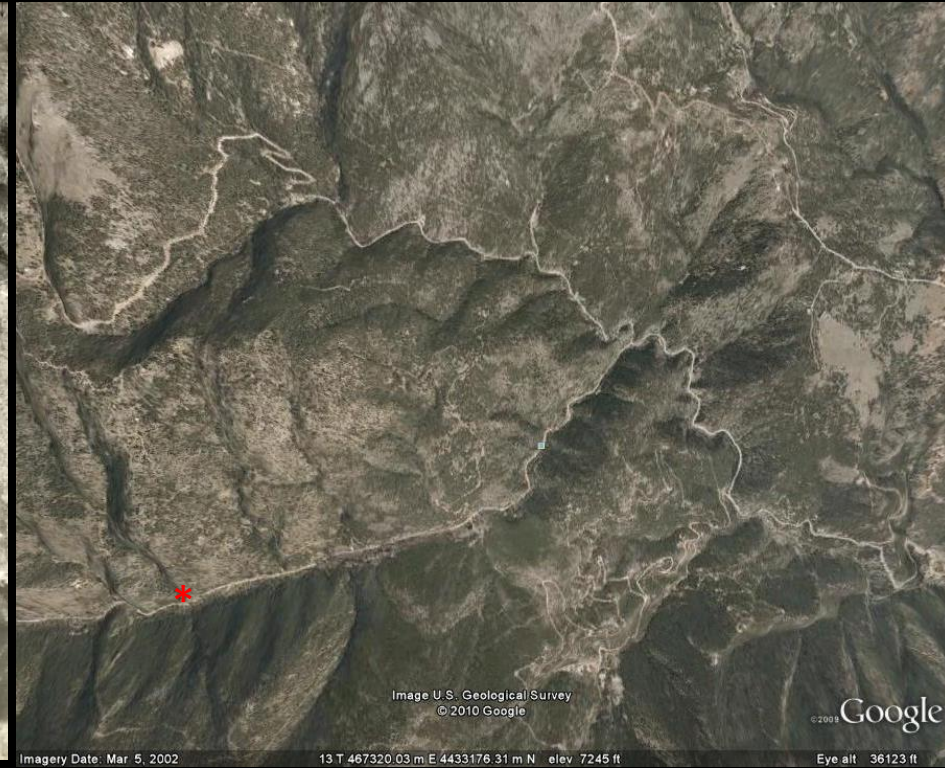
Mixed-severity
Mod-frequency

Upper Montane

1938

Fourmile Canyon Fire 2010

2002



<http://ucblibraries.colorado.edu/aerialphotos/photo.asp?PID=2511&CID=1&FLID=7>

*Fourmile Canyon Fire Start (approx)

Upper Montane Forests

These forests are *not uniformly denser*. Densities have increased on drier, south-facing slopes. In many places there is little change in density with fire suppression.

Extensive thinning to create open woodlands will restore only portions of these forests.

Fire mitigation and climate change adaptation are different from forest restoration.

Boulder County Forests



Infrequent
High-severity



Subalpine
>9000'

Upper Montane
7400-9000'

Lower Montane
6000-7400'

Frequent
Low-severity



Forest types and fire regimes vary by location

Boulder County Forests

Fuels ↔ Climate
↙ ↘
Ignition

Fuels ↔ Climate
↙ ↘
Ignition

Fuels ↔ Climate
↙ ↘
Ignition



Subalpine
>9000'

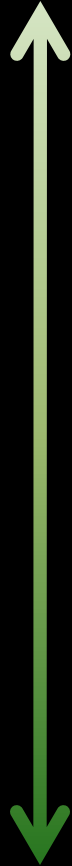
Upper Montane
7400-9000'

Lower Montane
6000-7400'

Controls on fire regimes also vary by location

Boulder County Forests

LOW restoration need



Subalpine
>9000'

Upper Montane
7400-9000'

Lower Montane
6000-7400'

Charles Pfeil

Opportunities for **restoration** also vary by location

HIGH restoration need

Forest restoration need in Boulder County

High elevation subalpine



Low elevation ponderosa pine



Which of these forests is in need of restoration?

Forest restoration need in Boulder County

High elevation subalpine



Low elevation ponderosa pine



Which of these forests is in need of restoration?



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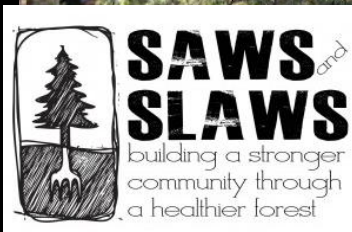
Patrick Cullis

- Historical fire regimes: effects of past fire suppression on restoration need
- Growth of the **wildland-urban interface** (WUI) increases fire risk
- Opportunities for forest restoration and reducing risk as more fires come our way

Fire Risk Mitigation

Fire risk is not simply related to wildland fuels,
but also where people live.

Fire mitigation reduces fuels (in forests, around homes) in order to protect people and property, regardless of restoration need.

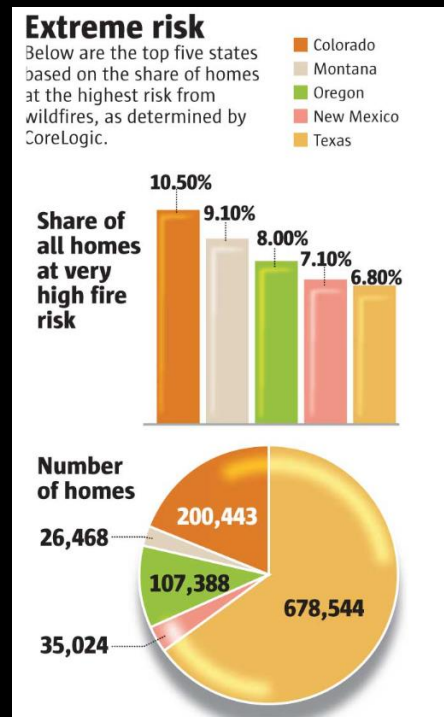


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Wildland-Urban Interface (WUI):

- 35% growth in homes in last decade
- 60% of this zone has been developed
- #1 densest development in Colorado, # 10 in the West

Headwaters Economics

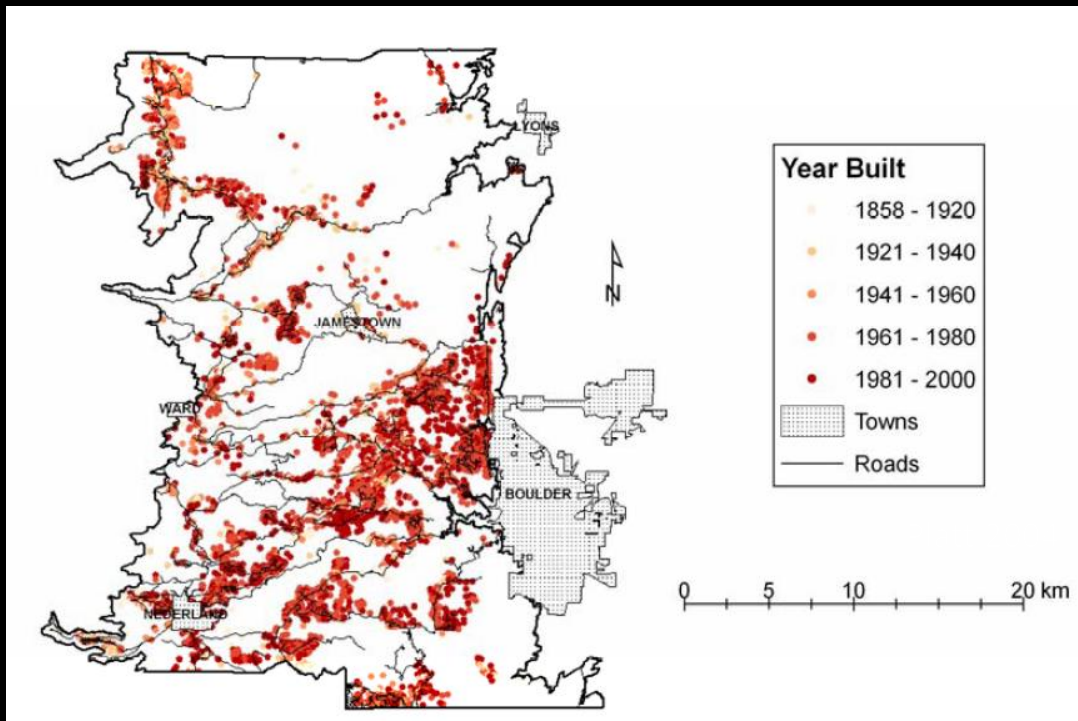


Denver Post/CoreLogic



Boulder County

Wildland-Urban Interface (WUI):

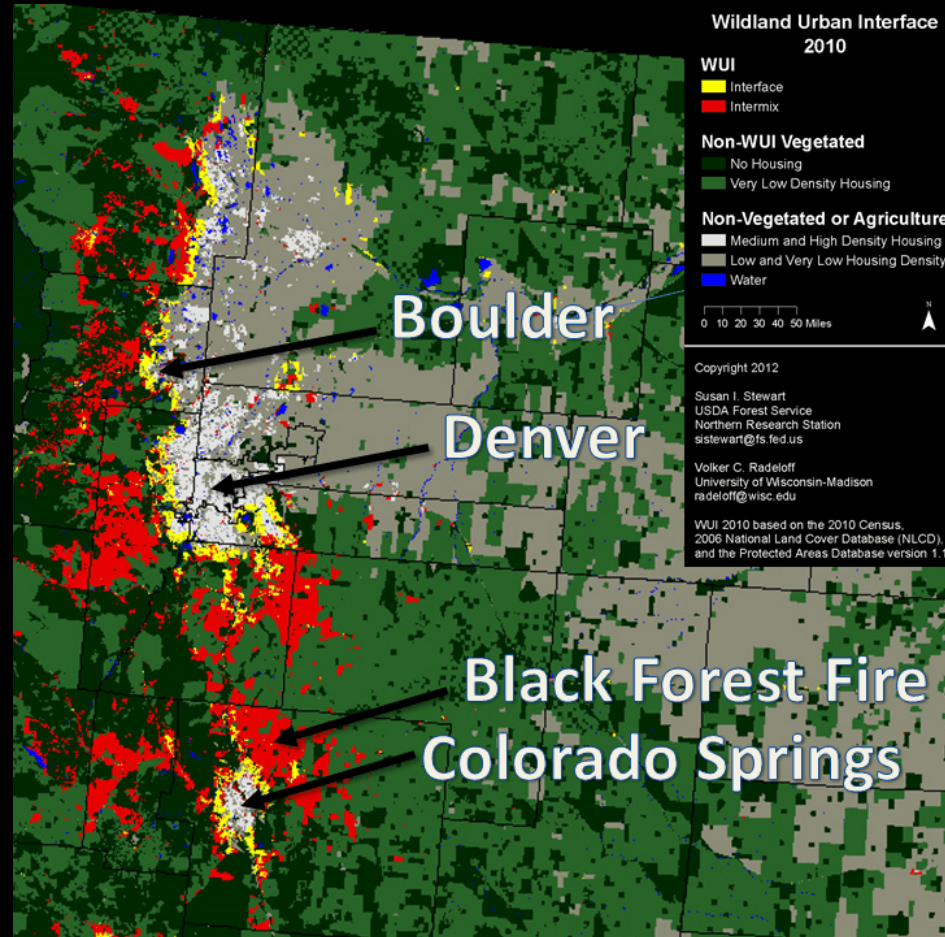


Platt et al. 2011



Boulder County

Wildland-Urban Interface (WUI):



WUI: areas of developed private lands adjacent to fire-prone forest increase wildfire risk and cost.

Boulder County

Wildland-Urban Interface (WUI):

- We cannot only manage public forests to solve our wildfire problem.
- Private land is 70% of the WUI in the West; 2/3rds of Fourmile Fire was private land.
- High priorities are managing fire risk in forests in and near communities on federal and private lands.



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- Historical fire regimes: effects of past fire suppression on restoration need
- Growth in the wildland-urban interface (WUI): increases fire risk
- Past and future **trends in wildfire**

Recent Fires in the Front Range

Hayman Fire (2000)



Dome Fire (2010)



High Park Fire (2012)



Walker Ranch Fire (2000)



Left Hand Fire (2011)



Waldo Canyon Fire (2012)



Fourmile Fire (2010) from Overland Fire (2003)

Lower North Fork Fire (2012)

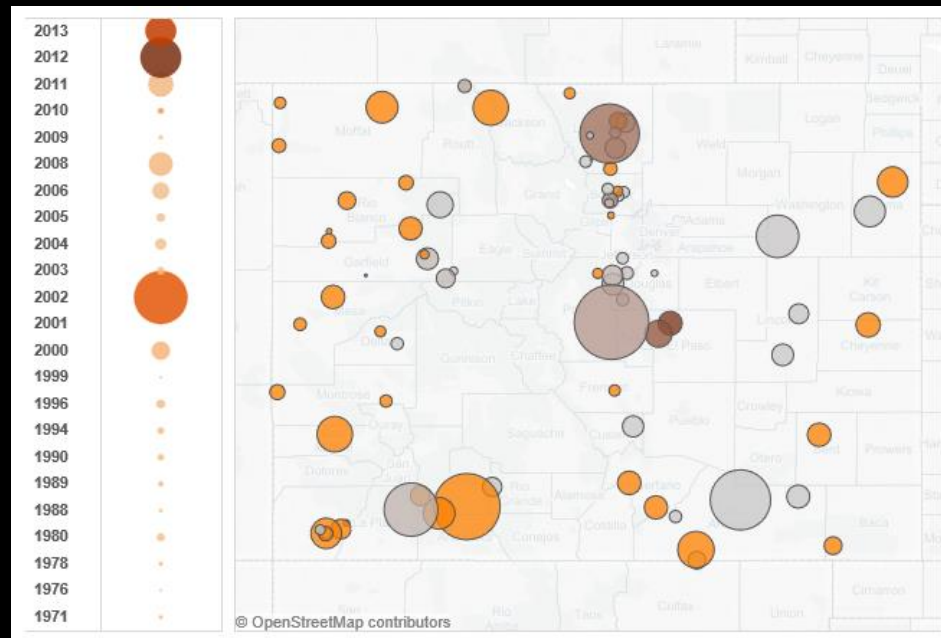


Back Forest Fire (2013)

Frequent, destructive wildfires likely to become the new norm
with warming and further WUI development

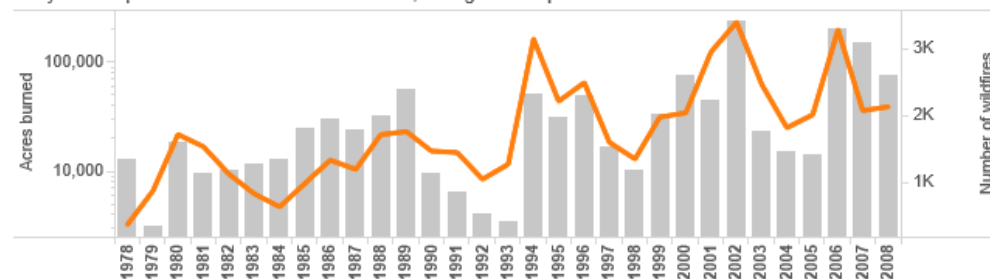
Fourmile fire (2010) behind Black Tiger Fire (1988)

Major Colorado wildfires 1971-2013



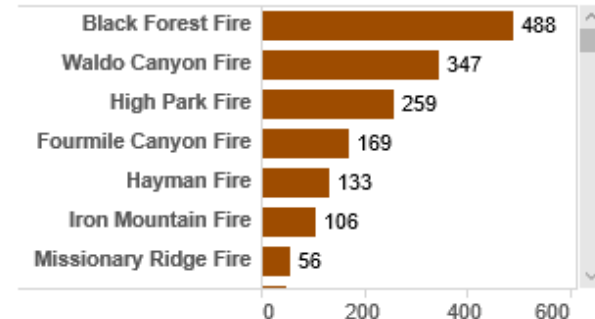
All wildfires 1978-2008 *click bar or line point for information*

Gray bars represent number of acres burned, orange line represents number of fires



Source: Colorado State Forest Service

Structures destroyed

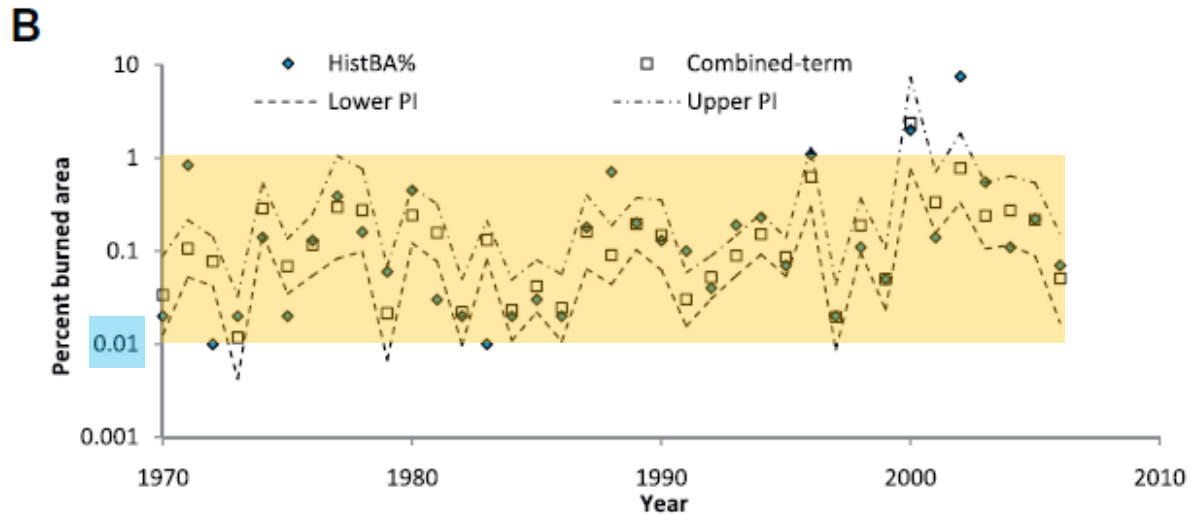


Climate and wildfire trends last 30 years

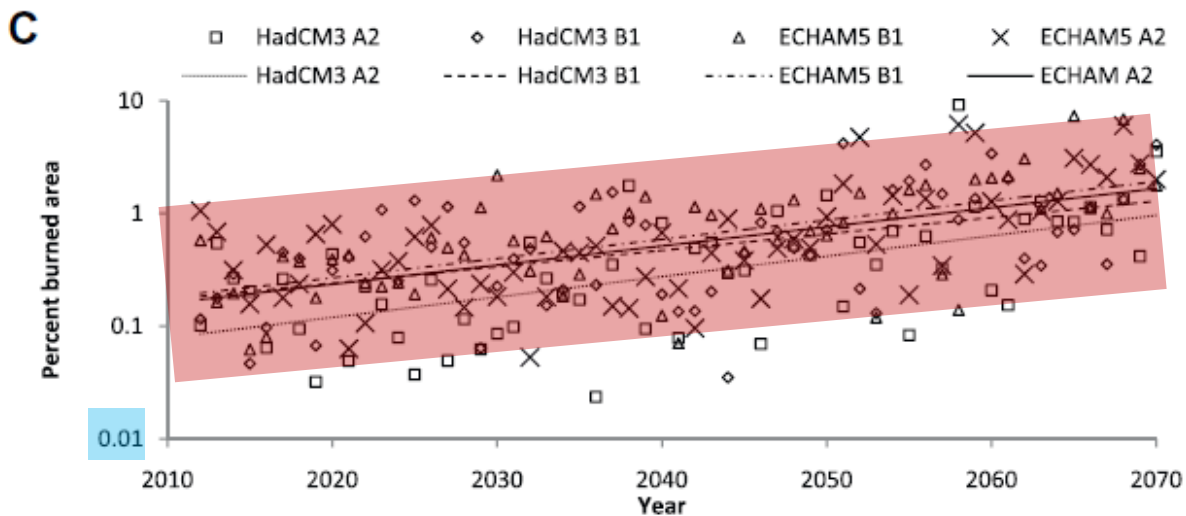
- 2° F warmer
- Snowmelt 1-4 wks earlier
- Fire season 5-7 mos longer
- 2x as many large wildfires
- 3x as many homes burned
- 4x as many fire fighter deaths
- Suppression costs \$1-3 billion

Wildfire Trends S Rockies

Historical



Predicted





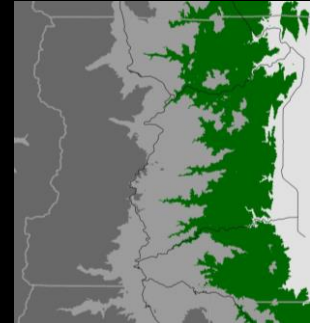
Boulder County



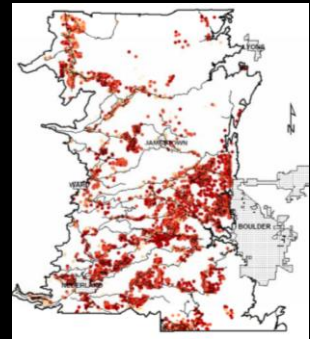
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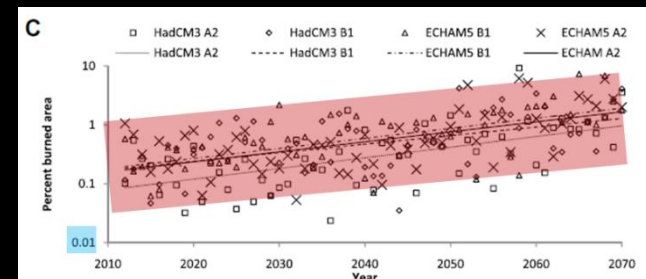
Forest restoration need primarily at lower elevations



Fire risk mitigation in the wildland-urban interface (WUI)



Wildfire will be more common



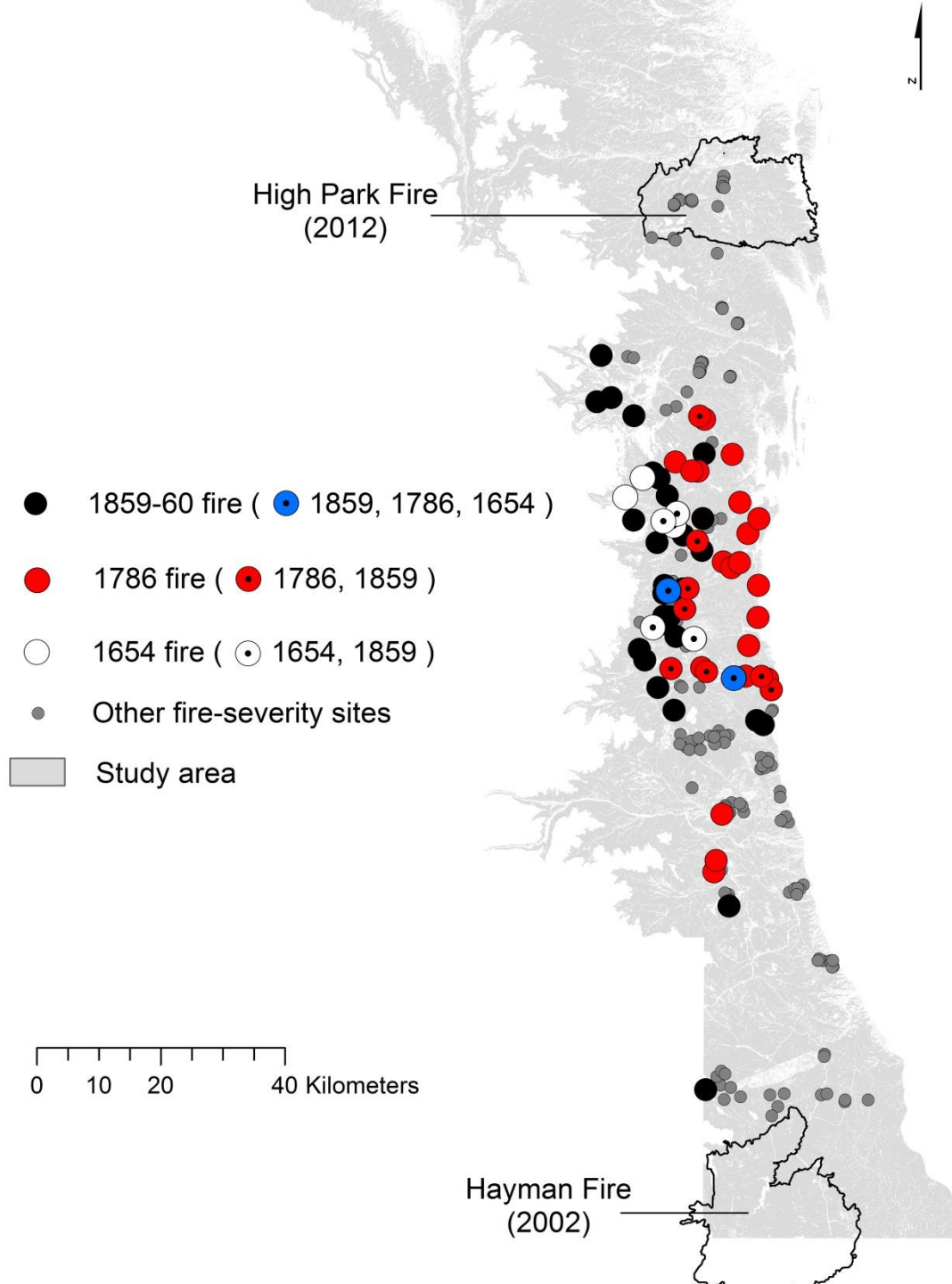
Questions?



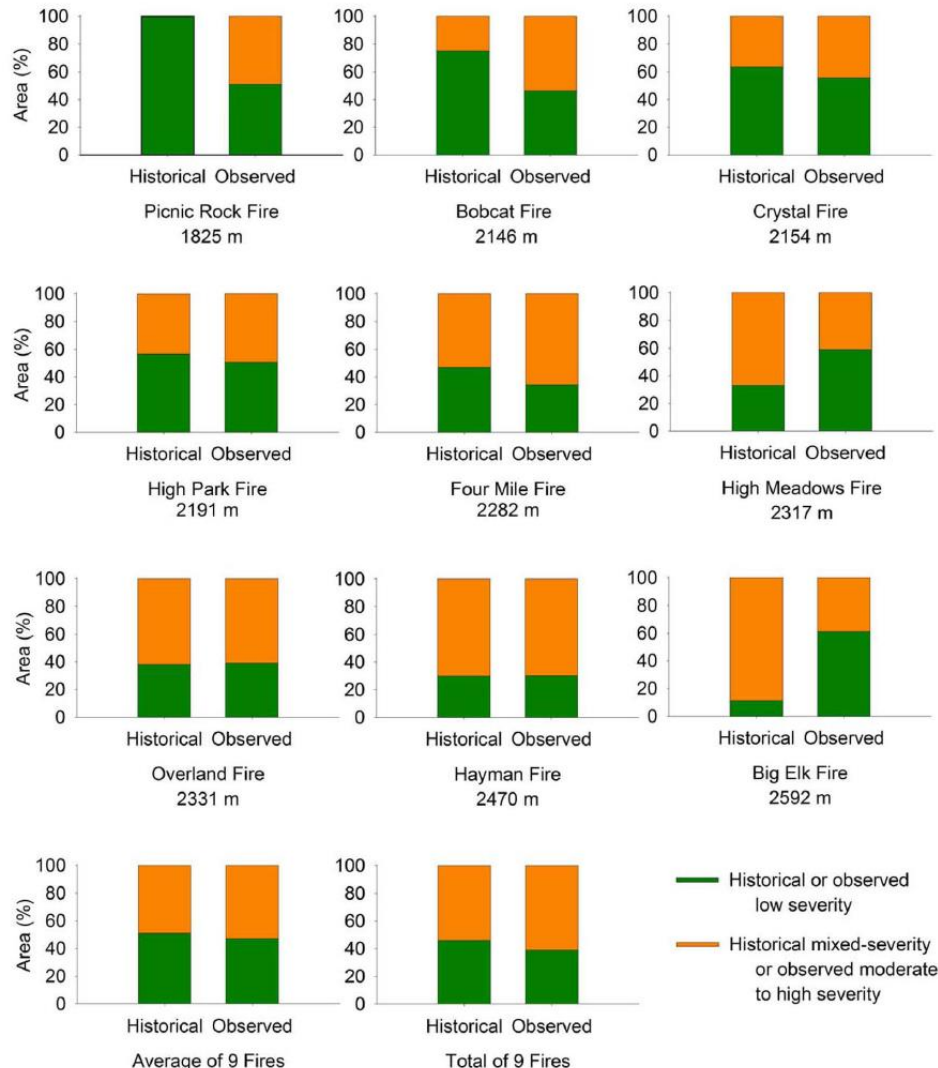
Thanks to my collaborators: Tom Veblen, Rosemary Sherriff, Rud Platt,
Meredith Gartner, many others; and to my funding sources:
Smith Fellowship, National Science Foundation, Wilburforce Foundation



Doug Sundseth



Recent fire severity not very different from historical



Sherriff et al. 2014

Fourmile Fire Severity & Trts

Fire 6200 ac, Trt 600 ac (10% of fire)

- Trt area had lower burn severity than similar untreated areas
- But fuel trt not a top predictor of overall burn severity, b/c so little treated

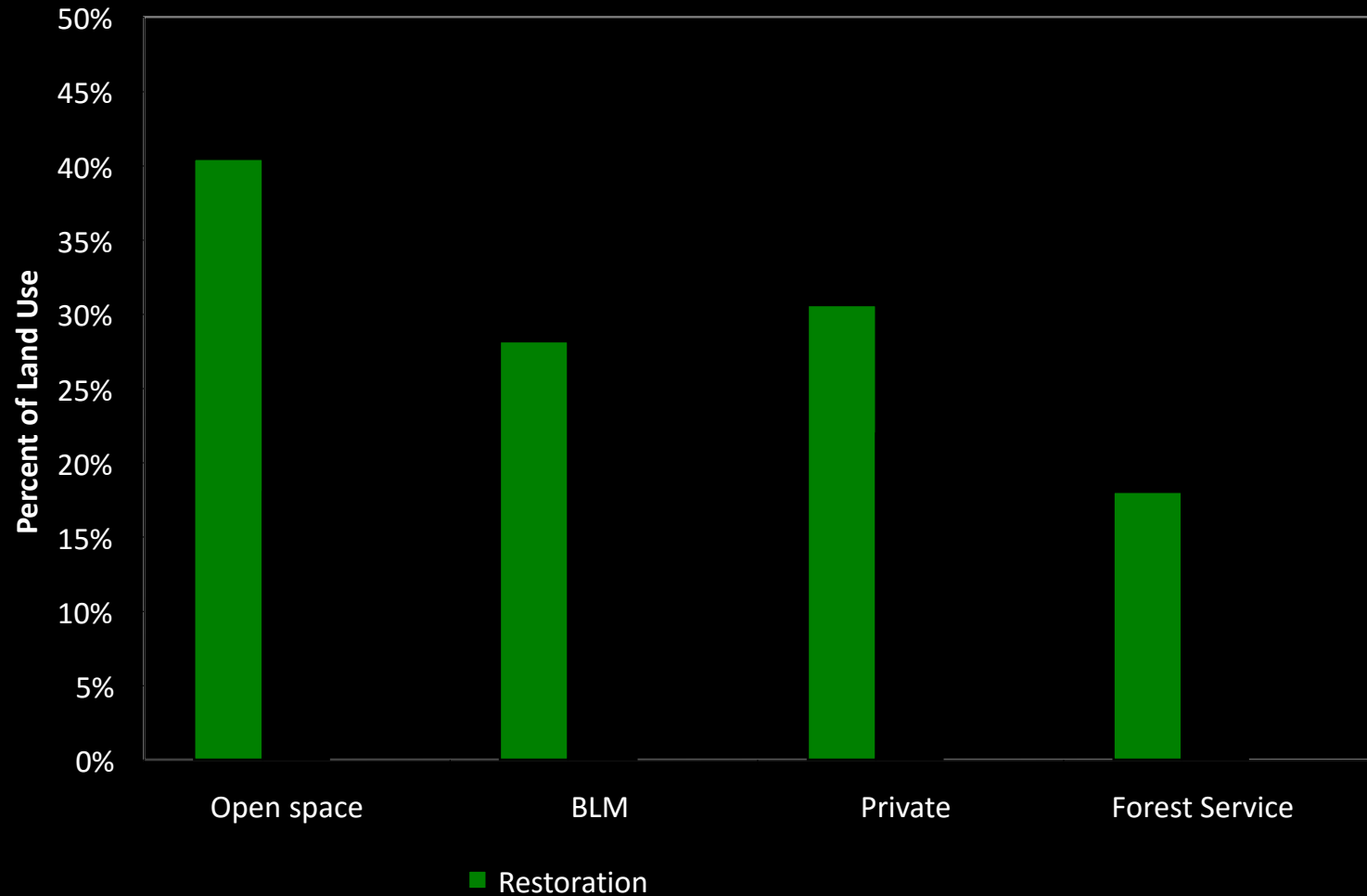
Gartner, CU Dissertation, 2015

High Park Fire Severity & MPB

“did not find statistically significant evidence that infected stands were more likely to burn severely than similar uninfected stands”

Stone, CSU Thesis, 2015

Forest Restoration opportunities by ownership in ponderosa pine zone of Boulder County



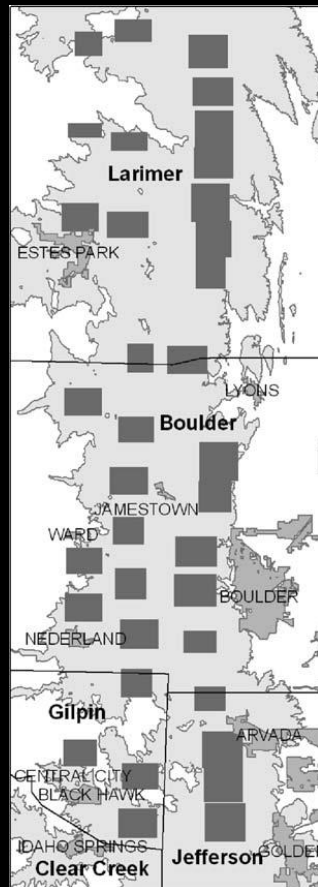
Management Implications

Impacts of creating novel forest conditions?



Similar to tree-ring evidence, aerial photo comparisons show the highest increase in tree density is in areas characterized by:

- low elevations
- ponderosa pine dominance
- low historical tree density/cover



Elevation	Percentage of study area	Mean
1737–2084 m	11%	13%
2085–2431 m	47%	5%
2432–2778 m	38%	0%
2779–3125 m	5%	2%
Dominant vegetation		
Lodgepole pine	17%	–1%
Mixed conifer	30%	0%
Ponderosa pine	45%	8%
Shrub	5%	5%
1938/1940 cover		
0–25%	21%	17%
25–50%	19%	15%
50–75%	22%	0%
75–100%	38%	–10%